it the spectra of various metallic vapours are examined till some familiarity is acquired with different spectra. Finally, a polariscope is made and different objects for examination are devised. Our space is more than exhausted, and we cannot follow the teachers further in their work. Time will, no doubt, bring greater experience and improve an already admirable course.

As we remarked in a former article, the good work done by the Department must sooner or later indirectly affect all classes. We trust the time is not far distant when the pressure of public opinion will lead men and women alike to feel but half educated if they have no acquaintance with the living facts and solid ground of nature. The happy results of such a change will soon become apparent. Already, indeed, society is becoming more interested in science. Some knowledge of the methods and results of scientific inquiry is penetrating the population. New habits of thought and modes of reasoning are spreading widely. A juster estimate of the position of the scientific explorer is being held. At the same time a truer knowledge of nature is diffusing more profound and doubtless more reverent conceptions of the orderly mystery that surrounds us.

CARUS AND GERSTAECKER'S "HANDBUCH DER ZOOLOGIE"

Handbuch der Zoologie. Von Jul. Victor Carus und C. E. A. Gerstaecker. (Leipzig : Engelmann.)

THE second volume of this work appeared in 1863, the first part of the first volume in 1868, and at length the book is completed by the appearance of the second part of the first volume in 1875. It is somewhat late in the day to review the earlier parts of the undertaking, but looking at it as a whole, we do not hesitate to say that the "Handbuch" in which Prof. Carus has had the chief share (the Arthropods alone are treated by Prof. Gerstaecker) is eminently useful and worthy of his high reputation for perspicacity and practical good sense. There are few men to whom zoologists both in this country as well as in his fatherland, are so much indebted for solid help in their labours of research or of instruction as to Prof. Victor Carus. Who has not felt grateful to him for the "Bibliotheca Zoologica," which bears his name? What naturalist of this generation has not consulted, as a storehouse of inexhaustible treasure, the "Icones Zootomicæ," which, after twenty years, continues to hold its place as the most valuable pictorial treatise on the Invertebrata which we possess? Prof. Carus has further served his countrymen by acting as the competent translator of Mr. Darwin's works—and to us he has lent timely aid by discharging for two years the duties of the Edinburgh chair of Natural History in the absence of Prof. Wyville Thomson. In an enumeration of the labours of this kind for which zoologists have to thank Prof. Carus, we must not omit the volume on the history of Zoology—published in the Munich series of histories of the sciences—a work which is full of the most interesting details of the early beginnings and strange developments of the study of animal form.

It will not be out of place, whilst strongly recommending this book to the reader as a most trustworthy, succinct, and withal ample exposition of the facts of animal morphology in especial relation to the "system" or classification of the Animal Kingdom—to say a few words as to its method and order of treatment. The first volume (that most recently published) contains the Vertebrata, the Mollusca, and Molluscoidea. The second volume treats of the Arthropoda, Echinodermata, Vermes, Cœlenterata, and Protozoa. The groups of the animal kingdom are thus discussed in a descending order, beginning with the highest : at the same time each section treating of a sub-kingdom is complete in itself. The section of the work treating of any one sub-kingdom starts with a brief definition of the group of some ten or fifteen lines in length. Then follow several pages treating of the characteristic disposition of the various organs and their variation in the following order, (1) general form, (2) integument, (3) muscular system, (4) skeleton, (5) nervous system, (6) organs of sense, (7) digestive canal, (8) respiratory organs, (9) vascular system, (10) urinary and generative organs, (11) development, metamorphoses and reproduction of parts, (12) geographical and geological distribution, (13) chief systems of classification hitherto proposed, with an outline of the classification adopted by the author, brief definitions (about ten lines each) of the classes being introduced. After this we have the detailed consideration of each class, the highest being taken first. The same method is adopted in the exposition of the characters of the class as in the treatment of the sub-kingdom—as much as twenty-four pages being thus devoted to the class Mammalia. To the class follows an enumeration of its orders, each order being *briefly* characterised in the list and then taken in turn, the highest first, for more detailed treatment. Some additional facts with regard to each order beyond those introduced in the brief definition are given when it is thus taken in its turn, and under it are placed in succession with their characteristics briefly stated, the families and sub-families and genera, the enumeration of the latter being *complete*. The principal genera are characterised—referred to their authors whilst synonyms and sub-genera are indicated. The work goes so far into detail as to cite under the genera many of the commoner or more remarkable species—with a statement of the geographical and geological distribution of the genus. After the description of an order or other large group, we usually find a bibliographical list referring the reader to the more important monographs relating to the particular group. Thus the "Handbuch" furnishes us—within the limits which are possible in an ever-growing science—with a treatise on comparative anatomy, combined with an exhaustive enumeration of the genera hitherto distinguished by zoologists, referred to a definite place in a scheme of classification. As the latest complete systematic treatise on the Animal Kingdom, and one executed with the exercise of most conscientious care, and a very exceptional knowledge of the vast variety of zoological publications which now almost daily issue from the press—this work is one which is sure to render eminent service to all zoologists. We can speak to the usefulness of the earlier volume, from an experience of some years, and there is every reason to believe that the one just completed will be found as efficient.

Having said thus much in favour of the "Handbuch," we shall proceed to point out some of its shortcomings, which

are rather theoretical than practical. Prof. Carus suffers in this book as in his "History" of Zoology, from the unphilosophic conception of the scope and tendencies of that division of Biology, which its early history has forced upon modern science. In England our newest and most conservative University continues to draw a broad distinction between what is called Comparative Anatomy and what is called Zoology. By some accident Zoology is the term which has become connected with the special work of arranging specimens and naming species which is carried on in great museums, and which has gone on in museums since the days when "objects of natural history," and other curiosities, first attracted serious attention in the sixteenth century. Accordingly Zoology, in this limited sense, has taken the direction indicated by the requirements of the curators of museums, and is supposed to consist in the study of animals not as they are *in toto*, but as they are for the purposes of the species-maker and collector. In this limited Zoology, external characters or the characters of easily preserved parts which on account of their conspicuousness or durability are valuable for the ready discrimination of the various specific forms—have acquired a first place in consideration to which their real significance as evidence of affinity or separation does not entitle them. From time to time the limited zoologists have adopted or accepted from the comparative anatomists hints or conclusions, and have worked them into their schemes of classification. But it does seem to be time in these days, when pretty nearly all persons are agreed that the most natural classification of the Animal Kingdom is that which is the nearest expression of the Animal Pedigree, that systematic works on Zoology should be emancipated from the hereditary tendencies of the old treatises, and should present to us the classes and orders of the Animal Kingdom defined not by the enumeration of easily recognised "marks," but by reference to the deeper and more thorough-going characteristics which indicate blood relationships. We have to note in the "Handbuch" the not unfrequent citation of superficial and insignificant characteristics in the brief diagnoses of taxonomic groups, which seems in so excellent a work to be due to a purposeless survival of the features of a moribund zoology that would know nothing of "insides," and still less of the doctrine of filiation. For instance, the very first thing which we are told of the Vertebrata in the short diagnosis of the group, is that they are "animals with laterally symmetrical, elongated, externally unsegmented bodies;" of the Fishes, that they have the "skin covered with scales or plates, seldom naked;" of the Mollusca, that they have a "laterally symmetrical, compressed body devoid of segmentation, often enclosed in a single (generally spirally-twisted) or double calcareous shell." It would be unjust to suggest that Prof. Carus, who long ago did so much to establish zoological classification on an anatomical basis, is not fully alive to the necessity, at the present day, of taking the wide biological view of animal morphology; but certainly the form in which parts of the book are cast, savours of the past epoch. It may be said that the object of the book is to present the "facts" of Zoology in a logical order; and that this sufficiently explains the arrangements to which objection might be taken as above, viz. the commencing with the higher instead of the lower groups, the prominent position assigned to external and little-significant characters, the absence of any recognition of the leading doctrine of modern Zoology, the doctrine of filiation. To this there is nothing to say excepting that of the very *many* logical methods of treatment possible in a handbook of Zoology, many are easy to follow out, and that one, which aims at presenting a logical classification of the kind spoken of by Mill, in which objects "are arranged in such groups, and those groups in such an order as shall best conduce to the ascertainment and remembrance of their laws," is a very difficult one to follow out. This kind of classification involves nothing less than an attempt (however inadequate) to trace the Animal Pedigree; for the laws to be ascertained and remembered are the laws of Heredity and Adaptation. We may regret then that so able a zoologist as Prof. Carus has remained in the old grooves and not ventured on to the inevitable track where Gegenbaur and Haeckel have preceded him.

It is in the same spirit that we draw attention to one or two features in the logical—or as it is sometimes called "objective"—classification adopted by Prof. Carus. He recognises the Molluscoidea as a main division of the Animal Kingdom, and places in it besides the Brachiopoda and the Bryozoa, the Tunicata. It certainly does not seem likely that in the present year (which is that which gives date to the volume containing the Molluscoidea) he would, if attempting to indicate genealogical affinities in his classification, do what he does whilst working on the old lines, namely, place the Ascidians in association with forms so remote from them as it now appears are the Brachiopods, and separate them so entirely from their blood-relatives among Vertebrates.

It is also interesting to note how the desire to frame symmetrical groups which can be easily defined in a few words, and on the other hand the desire to mark the gaps and the relative development of the branches of the genealogical tree, operate so as to lead individuals influenced respectively by one or other of those desires to propose very different changes in commonly accepted classifications. Both methods may have their use to-day, but we cannot shut our eyes to the fact that the motive in all classifications for the future must be *genealogy*. The changes proposed in J. Müller's classification of Fishes, respectively by Carus and by Haeckel, exhibit well the divergence of the tendencies of the "formal" (we cannot grant them the monopoly of the word "logical") and of the "genealogical" school. Dr. Günther of the British Museum is followed by Prof. Carus in his proposal to reduce Johannes Müller's six sub-classes of Fish, viz. Dipnoi, Teleostei, Ganoidei, Selachii, Cyclostomi, Leptocardii, to four, by the fusion of the Dipnoi, Ganoidei, and Selachii. The discovery of the Australian Ceratodus, which does not possess a special aortic branch distributed to the incipient lungs, and is different from Lepidosiren and Protopterus in the structure of its aortic bulb and its limbs, has been made the occasion for this logical or rather formal simplification. On the other hand, Prof. Haeckel wishing to show the large gap—the long series of intermediate forms—which *must* have intervened between the development of certain of the branches of the pedigree recognised by J. Müller as sub-classes of Fish, and wishing to express the *relative* distance of

these branches from one another has, first of all (and we think with no exaggerated estimate of the gap to be marked out), removed the Leptocardii altogether from association with the other fish, and not only from association with them but from association with the remaining classes of Vertebrates. They stand alone as the group Acrania, whilst the remaining Vertebrata are the Craniata. The five remaining groups of Müller's fishes find their place with the Craniata, but one group is separated within that large division as having no jaws, no limbs, and an unpaired nostril; these are the Cyclostomi, which are placed by Haeckel apart from all the remaining Craniate Vertebrates. The steps of structural differentiation which must be passed through to connect the Lampreys with the lowest of the remaining groups of J. Müller's Pisces seems to warrant this. They, the Dipnoi, Ganoidei, Selachii, and Teleostei, all belong to the large division of the double-nostrilled, jaw-bearing Craniata; but Haeckel cannot feel that the logic of his method is fully carried out, if he does not mark more emphatically the divergence of the structural characters of Dipnoi from those of the remaining and dominant classes of Fish. The class of Fishes is restricted to the three sub-classes of Selachii, Ganoidei and Teleostei; of which the first are the nearest representatives of the common ancestors of the Ganoidei and Teleostei, whilst the Dipnoi form a separate class of the Gnathostomous Craniate Vertebrata, reaching well forwards in the direction of the Amphibia, which were derived from Palæozoic Dipnoi, these in turn having been derived from Ganoidei. No doubt, it would not be possible to make any distinction between the ancestral Ganoidei and Dipnoi of Palæozoic times, had we them all before us; but that is no reason why, in framing our classifications, we should not use such breaks and divisions of groups as will best indicate in the tabular form the branching relationships of these and neighbouring organisms. The consideration of a case like the one just discussed renders it very obvious that the whole method and point of view of the naturalist who attempts to make classification the expression of the most important laws of organic structure, and therefore a genealogy, is different from that of the naturalist who endeavours to make his groups as few as may be convenient, and such that a large number of propositions can be affirmed with regard to them. The work of the latter is marred by adhesion to a conventional form, that of the former is inspired by a life-giving theory.

The absence of illustrations to Prof. Carus's "Handbuch" is not to be considered as a deficiency. In the first place, adequate illustration would immensely increase the price of the work; in the second place, we have already the "Icones," which may serve excellently as an atlas for much of the second volume. What we want now from Prof. Carus is another volume of "Icones," to contain illustrations of the Vertebrata.

E. RAY LANKESTER

OUR SUMMER MIGRANTS

Our Summer Migrants. By J. E. Harting, F.L.S., F.Z.S. (Bickers and Son, 1875.)

AMONG the many detailed differences between the lives of country and town residents there is one which has a marked influence on the lines of thought adopted by each. The townsman as a rule finds that his numerous avocations—more numerous as they must be to enable him to survive in the severer competition for a livelihood that is associated with the extra expense involved in a non-rural life—give him but little time or need for simple physical exercise as such. He has to form his ideas of the outside world by noting, as he passes through various thoroughfares, such things as attract his attention whilst he is on his way from one duty to another. When his work is over, his great idea is rest. The animated creation, humanity excepted, is a sealed book to him. The case of the country resident is very different. Either his slow-moving occupation in the open air allows him ample opportunity for looking around him, or he is compelled to "take a walk" in order to overcome the injurious influence of a sedentary employment. The charms of scenery soon, from frequent repetition, lose much of their fascination, and the observation of the surrounding changes continually occurring in the animated world become the chief objects of attraction. Of these none are more interesting than the movements of the birds, especially of those species which, instead of taking up their continuous abode with us, only condescend to visit our shores during those seasons of the year which best suit their delicate constitutions. These, our summer migrants, form the subject of the work before us; one which will be particularly attractive, as here presented, to all who have any predilections towards ornithology or the observation of natural phenomena, both on account of the valuable information it contains and the particularly elegant way in which, both typographically and as far as binding is concerned, the book has been brought out, and Bewick's accurate engravings have been reproduced.

Mr. Harting's object has not been to write a systematic work on the subject for beginners, but to collect the results of his own and other more recent observations, both as to the exact dates of arrival and departure of the migratory species of our avifauna, as well as attested facts with reference to the localities which they inhabit as their winter-quarters. Prof. Newton's new edition of "Yarrell's British Birds," Colonel Irby's "Ornithology of the Straits of Gibraltar," and the investigations of the late Mr. Edward Blyth, are amongst the most important sources from which the author is enabled to collect the observations which he classifies and employs so as to make them of special interest with regard to each individual species.

The controversy, not long ago revived, and carried on partly in this journal during 1869 and 1870 by Prof. Newton, concerning the eggs of the Cuckoo, makes the chapter devoted to that bird of special interest. On the subject of whether the hen bird is in the habit of always laying her eggs in nests of the same species of foster parent, Prof. Newton remarks (NATURE, vol. i. p. 75), "without attributing any wonderful sagacity to the Cuckoo, it does seem likely that the bird which once successfully deposited her eggs in a Reed Wren's, or a Titlark's nest (as the case may be) when she had an egg to dispose of, and that she should continue her practice from one season to another. We know that year after year the same migratory bird will return to the same locality, and build its nest in almost the same spot. Though the Cuckoo be